OF INTEREST TO TEACHERS

The experimental work now included in the plant physiology of the high school varies greatly in the number and kind of experiments. More important, pedagogically, is the variation in method for "plant experiments" may mean any of the following: the passive observation of work done wholly by the teacher, or the completion — almost as passively — of certain, definite, and detailed exercises to reach certain and definite results, or the working out of questions in which the accompanying suggestions, the lack of definite, predicted results, or the practical applications required demand independent reasoning and, perhaps, allow some slight opportunity for originality in method or device.

The questions "Should the physiological work in high school botany be more or less quantitative? If qualitative only, how can correct ideas as to time, amount, etc., be assured?" which appeared in the March Torreya have had several answers of interest. Those given this month are chiefly brief statements of the writers' opinions on the first part of the above question and in two cases lists of experiments are included. Later, Torreya will print as part of this same discussion longer papers by Mr. Joseph Y. Bergen, author of various well-known text-books on botany and by Professor Julius Sachs, of the department of secondary education in Teachers College, New York City.

Fred L. Charles, DeKalb, Illinois. — Chiefly qualitative, but not wholly so. Experiments by the pulpils individually or in groups of two; also demonstrations by the pupils.

We are now using Osterhout's "Experiments with Plants."

Fr. Holtz, Brooklyn, New York. — I do not think first year students in the high school are able to do or appreciate quantitative work very much. I do not believe that much quantitative work is done anywhere with such students. I believe thoroughly in physiological experiments, however. A little notion of quantitative work may be given by making *comparative* or *relative* studies which are not exact in quantities.

Willard N. Clute, Joliet, Illinois. — Physiological botany, to best serve the most people, should be entirely qualitative. The trouble with all of us is that we are too much in awe of the college and what it requires for entrance. The fact that so few take up botany in college is reason enough for our making the high school course such as described above.*

George W. Hunter, New York City. — Quantitative physiological work for the student of thirteen with the appliances he will find in the average New York home is out of the question. I prefer to set my problems for the student in such a way that he will work out the simplest kind of generalities himself. Then in the laboratory experiments may be set up and worked out as demonstrations. This shows to the student the value and place of *quantitative* work in the experiment — and often his own shortcomings.

Emmeline Moore, Trenton, New Jersey. — Physiological work in botany involves experimentaton of a quantitative as well as of a qualitative nature. It is true that the so-called qualitative experiments are more numerous than the quantitative ones in the lists of experiments which are usually performed but a plant is a living organism, and since it is a living organism "time" and "amount," in a general way, constantly enter as factors in the conditions which affect its life. A classification of experiments into quantitative or qualitative as such would tend to make the work, for the high school grade of pupils, artificial and mechanical and very probably obscure the principle involved in the experiment.

Elsie M. Kupfer, New York City. — I divide the physiological work in botany into two groups one of which includes experiments performed by pupils individually at home or in school, and the other those demonstrated by me in class. As my room is in use for work either by myself or some one else every period of the day, group work becomes impossible. I usually ask to have the experiment actually brought in, so as to avoid shirking.

The following list of the experiments performed by each pupil is not given in any related order:

1. On the force exerted by swelling seeds.
2. On the relation of water to germination.
3. On the relation of heat to germination.

* Editor's note. — See the discussion in the June TORREYA.

4. Food tests (starch, proteid, fats, and sugar) in all seeds studied (in class).

5. On response of roots to gravity.

6. On response of stems to gravity.

7. On conducting region of root.

8. On conducting region of stem.

9. Osmosis experiment to show the importance of water for rigidity of root (performed on carrot).

10. On positive phototropism of stem.

11. To prove that CO_2 is evolved by growing seeds (with lime water).

12. To prove that seeds use up oxygen in germinating.

13. To show transpiration.

14, 15. To show the functions of the veins of the leaf.

16. Etiolation experiment.

It seems to me that the qualitative side is all that we can profitably insist on in our high school course. I do not lay very much stress on the quantitative side, and doubt whether the conceptions of time and amount as applied to botany have very great value for pupils of this age.

L. S. Hawkins, Cortland, New York.— It seems to be advisable to take up the plant as a biological unit and in so doing to consider the general conditions governing the germination of seeds and the growth of seedlings. In this way we try to make the work, as far as possible with the apparatus at hand, quantitative. This work is followed by a series of experiments with the growth and function of the vegetative organs. I have tried two methods of having the experiments done. (1) Each student did each experiment. (2) One student from a group did one or more experiments and reported the results to the members of the group. In each case the results of the experiment were exhibited in the laboratory as material for demonstration of the explanation of the experiment. I find that the individual method is by far the more satisfactory. The number of pupils being so great in comparison to the room we have, we are obliged to have the experiments done at home and the results brought to class. I will enclose the list of experiments which represents the work done along the line of physiological work. Of course you understand that in this State there is a definite course for every school to follow.

1. To test seeds for starch.
2. To test seeds for proteid.
3. To test seeds for sugar.
4. To test seeds for fat.
5. To test seeds for mineral matter.
6. To determine the temperature best suited to seed germination and the growth of seedlings.
7. To determine the relation of moisture to seed germination and the growth of seedlings.
8. To determine the relation of air to germination.
9. To determine what gas is given off by germinating seeds.
10. To determine the relation of light to seed germination and to the growth of seedlings.
11. To determine the effect of soil upon seed germination and the growth of seedlings.
12. To determine the use of the cotyledons to the seedling.
13. To determine the use of the endosperm to the corn seedling.
14. To determine the cause of the arch of the hypocotyl.
15. To determine where the increase in length in the root is most rapid.
16. An experiment to show osmosis.
17. To determine where the root hairs are most numerous.
18. To determine the direction of growth of roots when uninfluenced by gravity.
19. The use of the corky layer to the stem.
20. The path of sap in the stem.
21. To show transpiration.
22. To show photosynthesis.
23. To show respiration of aquatics.

Under the title "Organizing a field trip," H. M. Benedict has an article in the April number of the Nature Study Review which is particularly *à propos* at this season of the year. His discussion of the subject is from the standpoint of a course in general biology but the matter contained is equally applicable to a course in botany. In his opinion, "The reason why the field excursion is so often unsatisfactory is that insufficient preparation is made for it. The plain fact of the matter is that a field trip requires more careful preparation on the part of the students than any recitation or laboratory period." He explains his methods by describing the preparation made for a specific trip. These include (1) a preliminary reconnaissance by the teacher of the region to be visited, and (2) a detailed outline and questions, similar to those in laboratory manuals, regarding the particular organisms to be observed. The pupils are to be drilled on these beforehand. Then, during the excursion, each is to discover for himself the answers to the questions given. The writer's plea is for excursions sufficiently limited in scope to allow of thorough work, and for careful preparation. He closes with the following: "The only seed from which a love of nature can grow is a fact personally discovered by the child. We may radiate the sunlight of enthusiasm and pour showers of loving appreciation but there can be no growth until the seed is planted."

RALPH CURTISS BENEDICT.

NEWS ITEMS

Dr. F. Noll, professor of botany at Halle, died on June 22 at the age of forty-nine years.

Mr. L. Lause Burlingame has been appointed instructor in botany in Stanford University.

Mr. C. E. Porter has been appointed professor of botany in the University of Santiago de Chile.

Dr. C. H. Shattuck, of Washburn College, has been called to the chair of botany and forestry in the State Agricultural and Mechanical College, at Clemson College, South Carolina.

Professor Edwin M. Wilcox, of the Alabama Polytechnic Institute, has been elected botanist of the Experiment Station and professor of agricultural botany in the University of Nebraska.

Dr. William A. Murrill, assistant director of the New York Botanical Garden, gave a two weeks' course of lectures in July